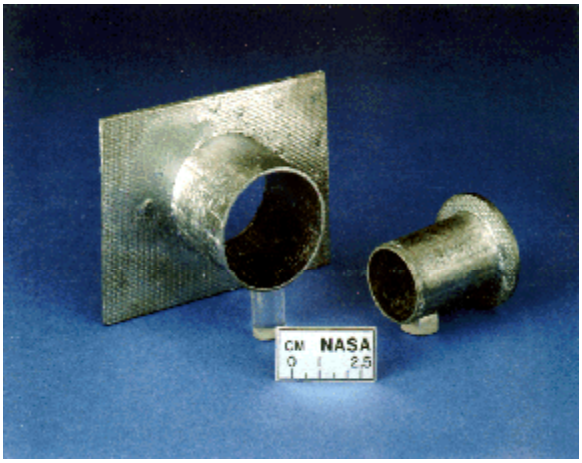
Method for Efficient Joining of Silicon-Carbide-Based Ceramic Materials Developed



Joined SiC/SiC ceramic matrix composite (CMC) plates and cylinders.

An affordable and flexible method of joining silicon-carbide- (SiC-) based monolithic ceramics and fiber-reinforced ceramic matrix composites (CMC's) is being developed at the NASA Lewis Research Center. This technology will make it possible for ceramic and CMC components to be used for high-temperature applications in aeropropulsion, launch, and onboard space propulsion systems. Our goal is to develop a joining approach that can be scaled up to provide joints between SiC-based CMC or monolithic ceramic components or subcomponents.

In this joining process, which is based on the SiC reaction processing method, carbonaceous mixtures are applied to the joint area and subsequently infiltrated with molten silicon. The molten silicon reacts with carbon to form SiC joints that contain a controllable amount of silicon. This approach can be controlled via modification of the reactive constituents to yield joints with tailored microstructures and properties. The approach should be affordable because precision joint machining is unnecessary, the reactive constituents are inexpensive, and a pressureless melt infiltration process is used to introduce the molten silicon. The flexibility of the process makes it applicable to the joining of any SiC-based monolithic or composite material, and the ready availability of the required processing equipment to commercial materials suppliers facilitates technology transfer.

Thus far, several types of commercially available and NASA-processed SiC ceramics--including reaction bonded, reaction formed, and pressureless sintered SiC--have been joined. Joints having strengths that equaled or exceeded the strength of the base material were formed in reaction-bonded SiC. In addition, the ability to join CMC cylinders to CMC panels by using this reaction-joining approach has been demonstrated, as shown in the photo.

Lewis contacts: Dr. Mrityunjay Singh, (216) 433-8883, Mrityunjay.Singh@grc.nasa.gov; and J. Douglas Kiser, (216) 433-3247, James.D.Kiser@grc.nasa.gov
Author: J. Douglas Kiser
Headquarters program office: OA